

Zernike Fit Identity Test

February 28, 2019

1 Zernike Fit Identity Test

In which we demonstrate that we live in a rational universe: * create a surface matrix based off a single zernike coefficient * fit zernikes to this surface * then send those (reordered) zernikes to the Active Surface * the Active Surface should command actuators to make a surface identical to our original surface matrix (identity!)

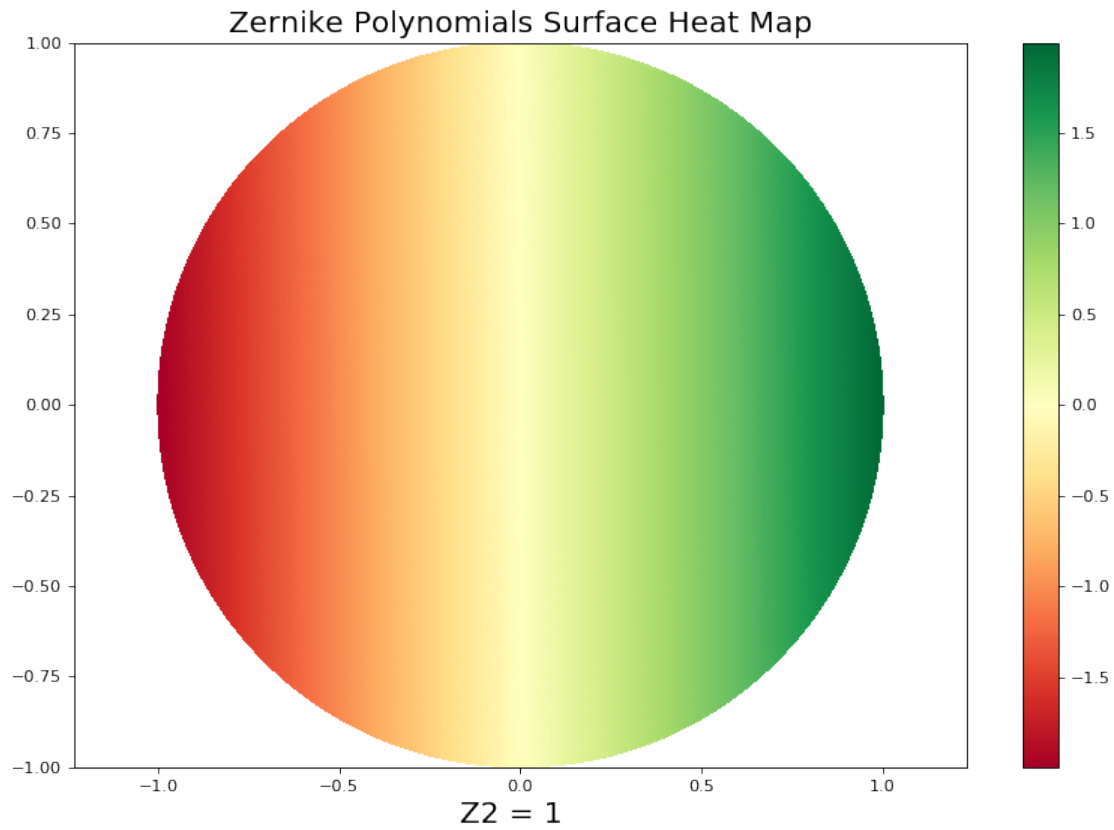
```
In [1]: #!/matplotliblib notebook
```

```
In [2]: import matplotlib.pyplot as plt
import numpy as np
import opticspy
```

1.1 Simulate surface

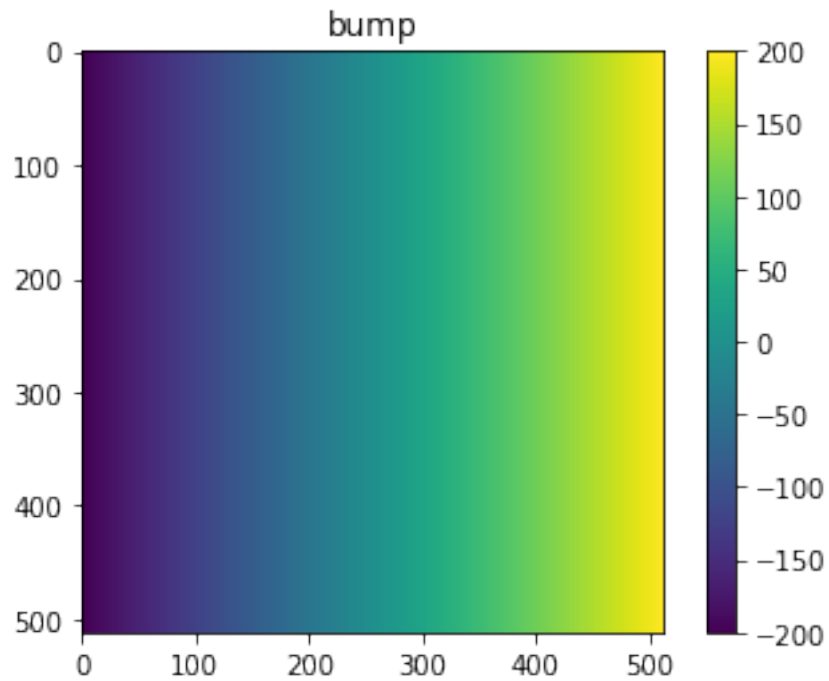
```
In [3]: z2 = opticspy.zernike.Coefficient(Z2=1)
z2.zernikemap()
```

```
Z2 = 1 Z11 x Tilt
```



```
In [4]: z2m = z2.zernikematrix(l=512) * 100.  
fig = plt.figure()  
ax = fig.gca()  
cax = ax.imshow(z2m)  
fig.colorbar(cax)  
plt.title('bump')
```

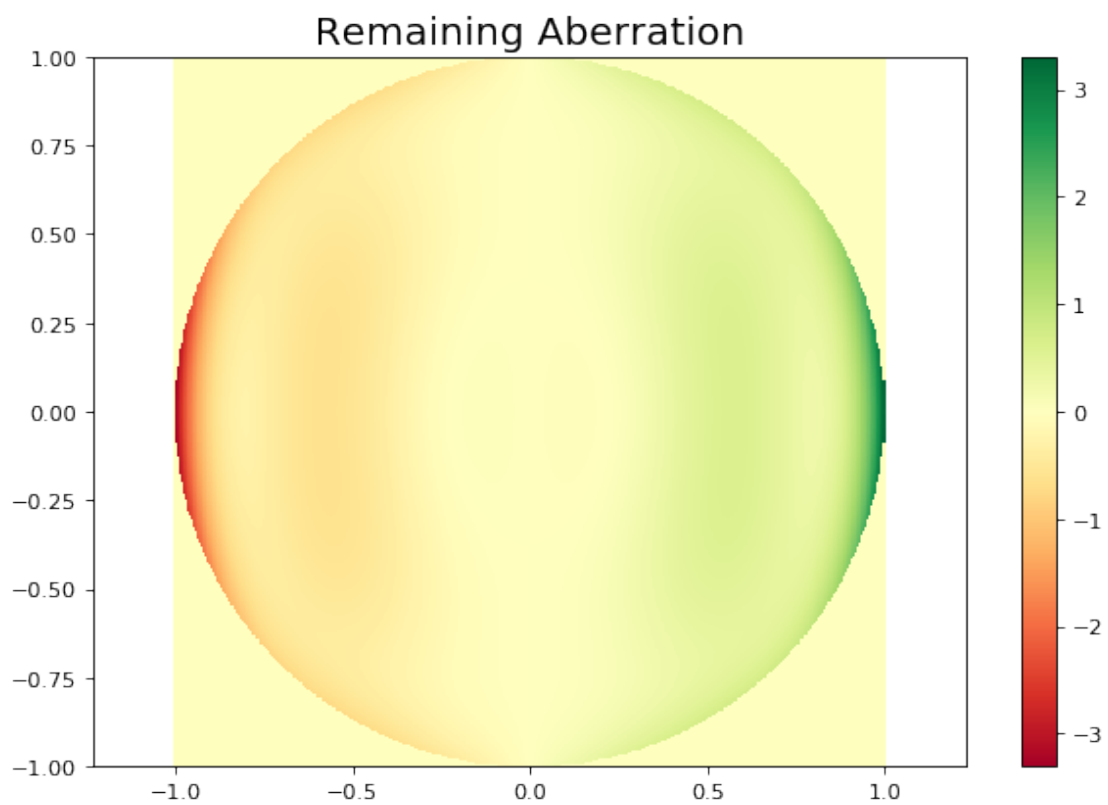
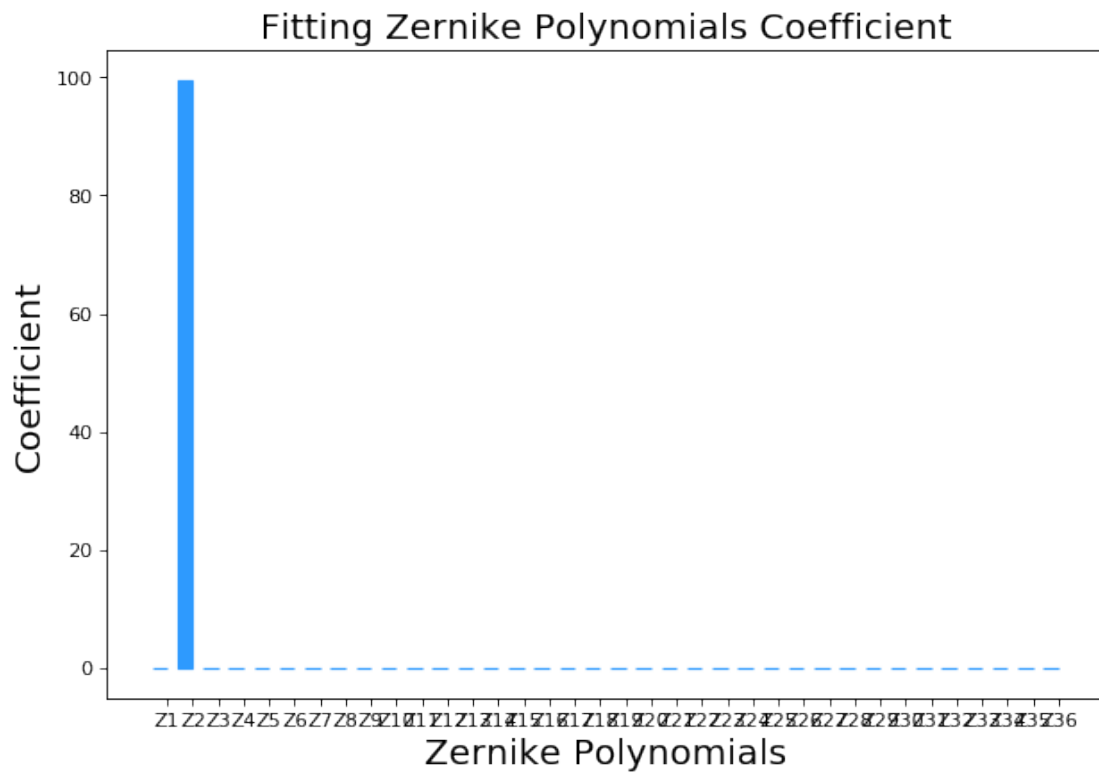
```
Out[4]: Text(0.5,1,'bump')
```



1.2 Fit to this surface

If opticspy can't fit the data that it generated in the first place, we need to get our money back.

```
In [5]: numZsFit = 36
        fitlist,C1 = opticspy.zernike.fitting(z2m,
                                             numZsFit,
                                             remain2D=1,
                                             barchart=1)
```



Zernike Polynomials List

	Z1		Z2		Z3		Z4		Z5		Z6		Z7		Z8		Z9		Z10	
	0.000		99.540		-0.000		-0.000		-0.000		-0.000		-0.000		-0.099		0.000		-0.051	
	Z11		Z12		Z13		Z14		Z15		Z16		Z17		Z18		Z19		Z20	
	-0.000		-0.000		-0.000		-0.000		-0.000		-0.121		-0.000		-0.062		0.000		-0.062	
	Z21		Z22		Z23		Z24		Z25		Z26		Z27		Z28		Z29		Z30	
	-0.000		-0.000		-0.000		-0.000		0.000		0.000		-0.000		0.000		0.000		-0.139	
	Z31		Z32		Z33		Z34		Z35		Z36		Z37							
	-0.000		-0.071		-0.000		-0.071		0.000		-0.021		0.000							

1.3 Reorder Zernikes

```
In [6]: from zernikeIndexing import noll2asAnsi, printZs
        # why does the fitlist start with a zero? for Z0?? Anyways, avoid it
        nollZs = fitlist[1:(numZsFit+1)]
        asAnsiZs = noll2asAnsi(nollZs)
        print "nolZs"
        printZs(nollZs)
        print "active surface Zs"
        printZs(asAnsiZs)
```

```
nolZs
[0]
[99.54, -0.0]
[-0.0, -0.0, -0.0]
[-0.0, -0.099, 0.0, -0.051]
[-0.0, -0.0, -0.0, -0.0, -0.0]
[-0.121, -0.0, -0.062, 0.0, -0.062, -0.0]
[-0.0, -0.0, -0.0, 0.0, 0.0, -0.0, 0.0]
[0.0, -0.139, -0.0, -0.071, -0.0, -0.071, 0.0, -0.021]
active surface Zs
[0]
[99.54, -0.0]
[-0.0, -0.0, -0.0]
[-0.051, -0.099, -0.0, 0.0]
```

```
[-0.0, -0.0, -0.0, -0.0, -0.0]
[-0.062, -0.062, -0.121, -0.0, 0.0, -0.0]
[-0.0, 0.0, -0.0, -0.0, -0.0, 0.0, -0.0]
[-0.021, -0.071, -0.071, -0.139, 0.0, -0.0, -0.0, 0.0]
```

```
In [7]: asAnsiZs[1]
```

```
Out[7]: 99.54
```

```
In [8]: np.save("/users/pmargani/bumpIdentityZs", asAnsiZs)
```

1.4 Send zernikes to Active Surface

We can't do this from the notebook because it's Sparrow code. But below we analyze the results from the scans we ran.

```
In [9]: from analyzeActiveSurface import *
```

```
In [10]: # Scan 17: using a magnitude of 1 for the simulated data
         # Scan 18: using a magnitude of 100
         # Note how we can't distinguish the ramp with a small amplitude, but at 100 we see the
         path = "/users/pmargani/tmp/simdata/TINT_210219/"
         scans = [17, 18]
         analyzeActiveSurfaceScans(path, scans, details=True)
```

```
Scan: 17
```

```
FITS: /users/pmargani/tmp/simdata/TINT_210219/ActiveSurfaceMgr/2019_02_22_16:47:39.fits
```

```
Zeros enabled: 0
```

```
FEM enabled: 0
```

```
Random enabled: 0
```

```
Zernikes enabled: 0
```

```
Thermal Zernikes enabled 1
```

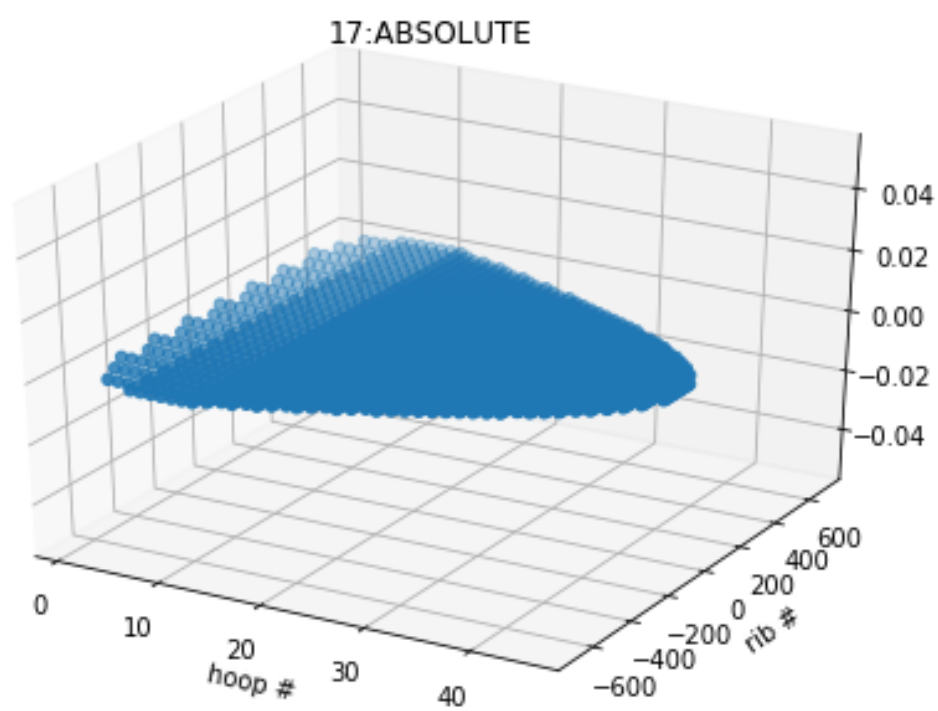
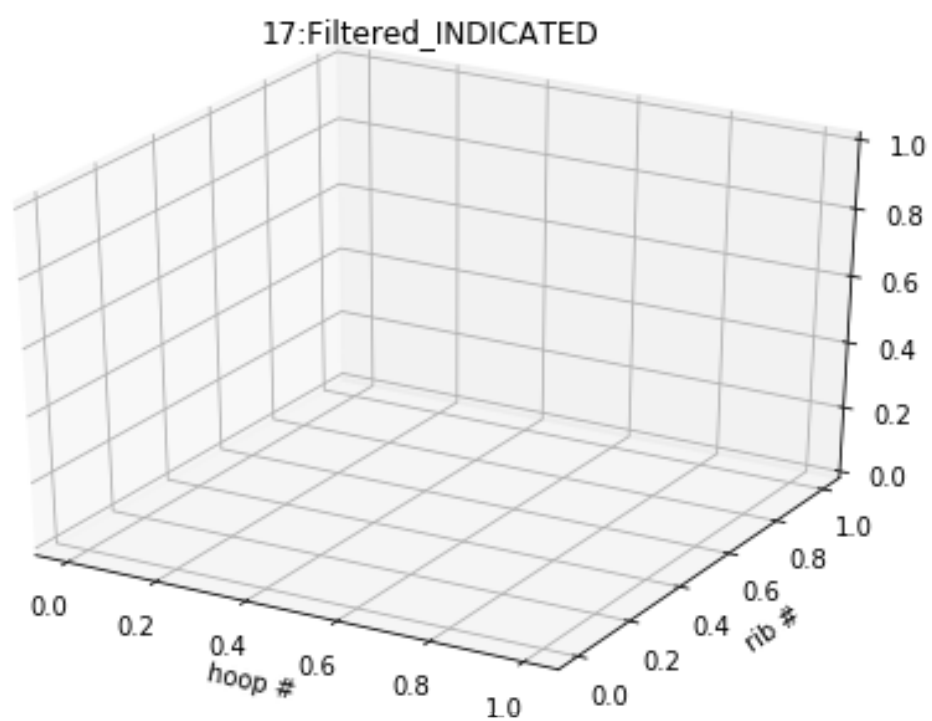
```
total indicated: 2209
```

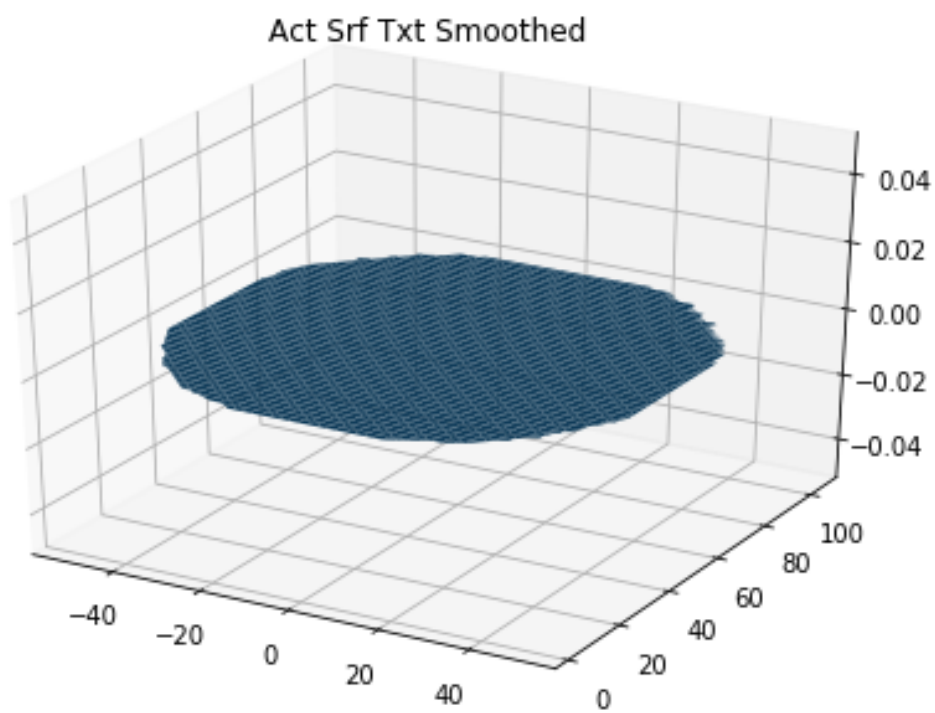
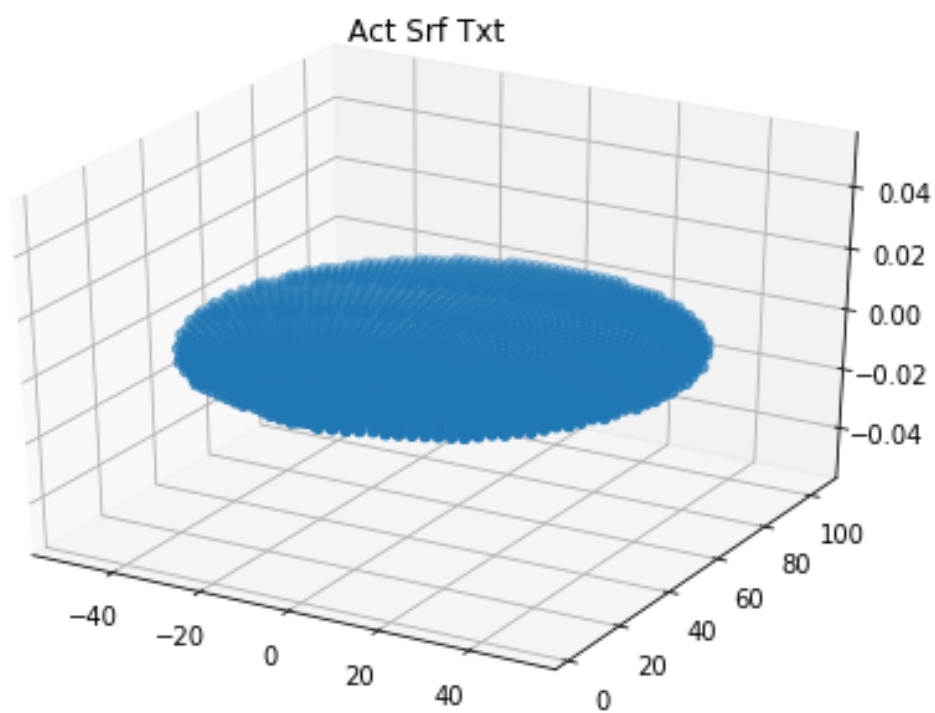
```
filtered indicated: 0
```

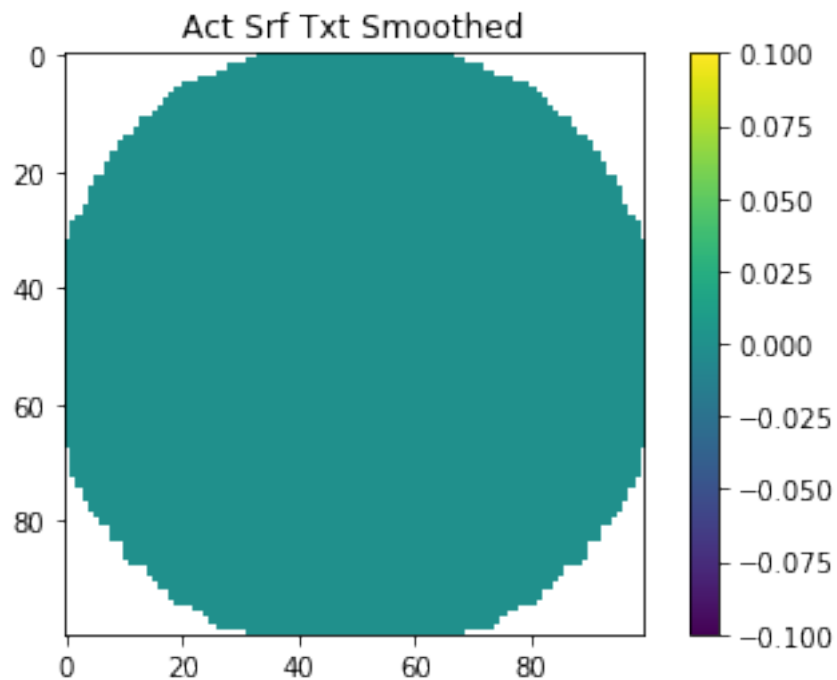
```
Txt: /users/pmargani/tmp/simdata/TINT_210219/ActiveSurfaceMgr/asdata.17.txt
```

```
['# Active surface commands at 39.491978\n', '# Zero points are Off, FEM corrections are Off\n']
```

```
Smoothed data using 100 x 100 size grid, sigs: 0.100000, 0.100000
```

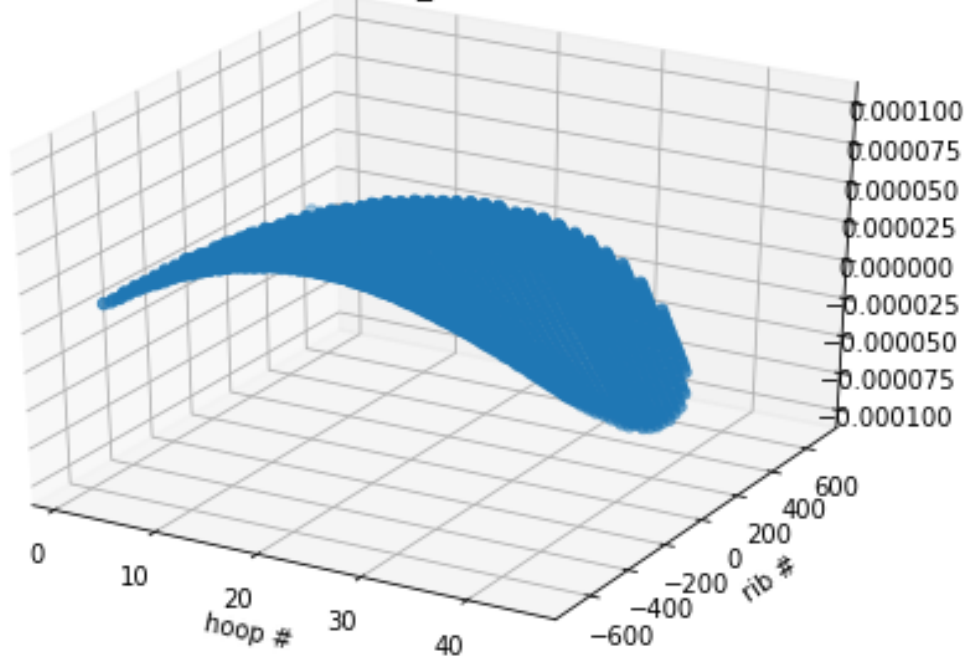




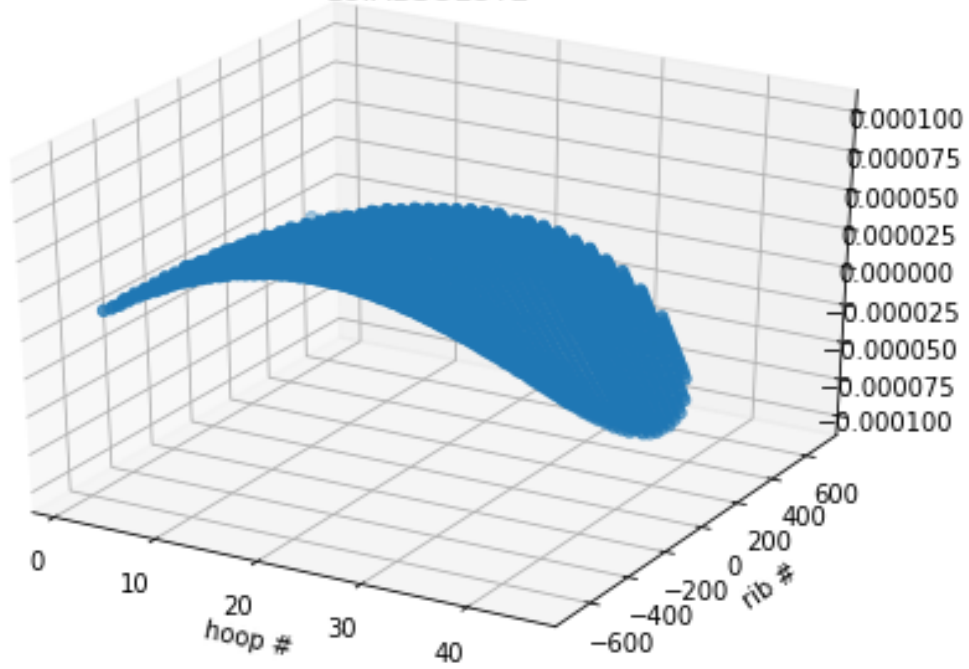


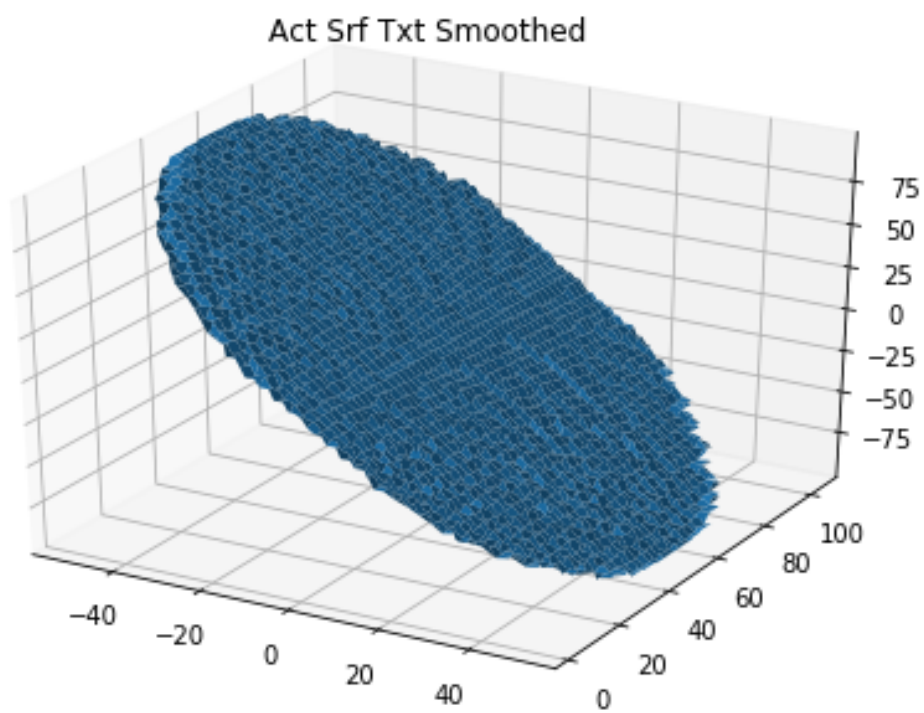
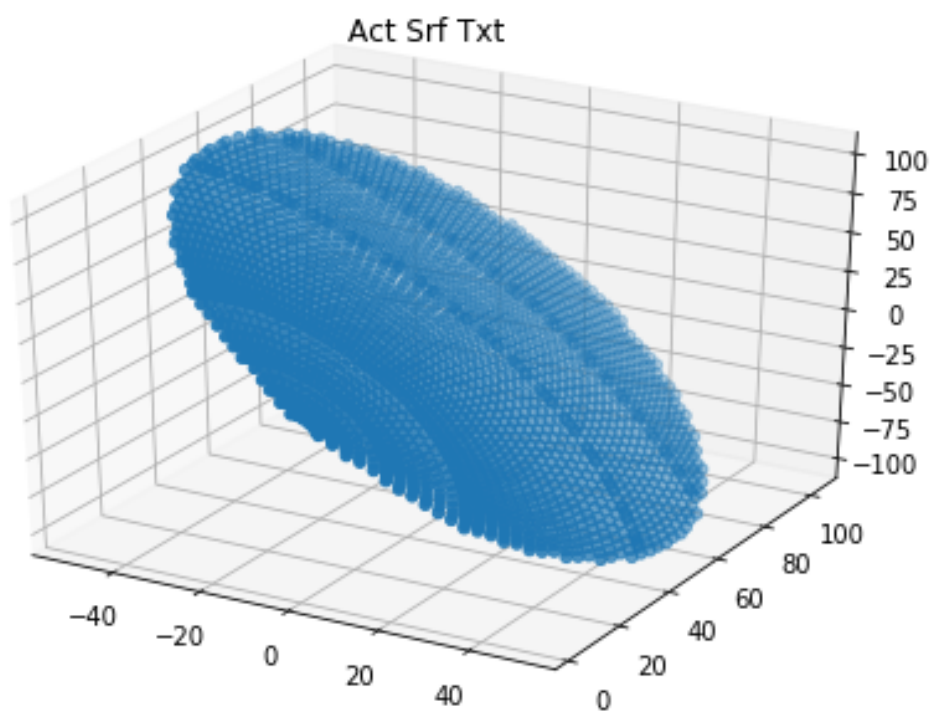
Scan: 18
 FITS: /users/pmargani/tmp/simdata/TINT_210219/ActiveSurfaceMgr/2019_02_22_16:53:25.fits
 Zeros enabled: 0
 FEM enabled: 0
 Random enabled: 0
 Zernikes enabled: 0
 Thermal Zernikes enabled 1
 total indicated: 2209
 filtered indicated: 2204
 Txt: /users/pmargani/tmp/simdata/TINT_210219/ActiveSurfaceMgr/asdata.18.txt
 ['# Active surface commands at 40.341707\n', '# Zero points are Off, FEM corrections are Off\n']
 Smoothed data using 100 x 100 size grid, sigs: 0.100000, 0.100000

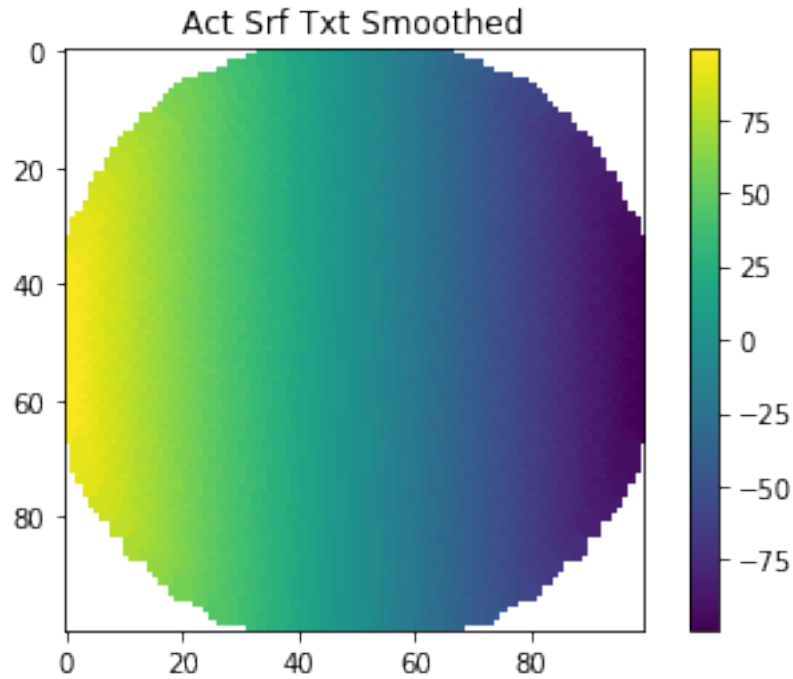
18:Filtered_INDICATED



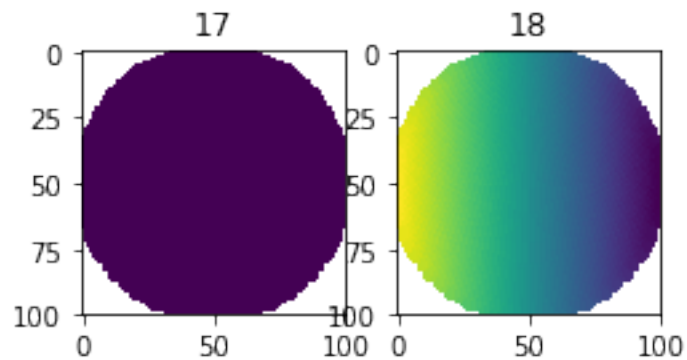
18:ABSOLUTE







```
[ '# Active surface commands at 39.491978\n', '# Zero points are Off, FEM corrections are Off\n']
[ '# Active surface commands at 40.341707\n', '# Zero points are Off, FEM corrections are Off\n']
```



1.5 We have Identity!

The fact that the picture labeled '18' above looks like the zernikemap from the beginning means our identity test worked.

In []: